Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

PUBLIC HEALTH REPORTS.

UNITED STATES.

[Reports to the Surgeon-General, Public Health and Marine-Hospital Service.]

Pathological conditions found in rats—Observations based upon examination of 50,000 rats in the laboratory of the Public Health and Marine-Hospital Service, San Francisco, Cal.[a]

[By Passed Assistant Surgeon GEORGE W. MCCOY.]

In the systematic examination of rats for plague infection a number of interesting pathological conditions have been observed. Many of these have counterparts in human pathology and consequently they present no difficulty in diagnosis; others are conditions not comparable with any found in man.

Two of the animal parasites observed, *Trichinella spiralis* and *Hymenolepis diminuta*, are also parasitic for man, and the rat may be indirectly the source of human infection.

These notes are not a complete record of the conditions met with in rats here, but represent for the most part only lesions that are to be differentiated by the more or less cursory examination we have been able to make in the limited time available for this purpose. These observations are based upon the examination of about 50,000 rats that have been necropsied during the past four months.

ANIMAL PARASITES.

Trypanosomiasis.—In the examination of stained smear preparations for *Bacillus pestis*, trypanosomes have been occasionally observed. The infection is present in about 0.4 per cent of the rats examined. The parasite is probably *Trypanosoma lewisi*, the common trypanosome of rats. Passed Asst. Surg. B. J. Lloyd (California State Journal of Medicine, April, May, June, 1904) found this parasite in 25 per cent of a large number of rats examined during the previous plague campaign here. Only once has it appeared to cause lesions. This was in a *Mus norvegicus* found dead in our stock cage. All of the mesenteric glands were found to be much enlarged and markedly hemorrhagic. No explanation was to be found for this condition except the presence of a large number of trypanosomes in smears from these glands. Two white rats were inoculated intraperitoneally with an emulsion of the glands, but without success in the reproduction of the infection. Plague infection was definitely excluded in this case.

---

[a] See Report on laboratory work in relation to the examination of rats for plague at San Francisco, Cal., Public Health Reports, July 24, 1908.

Trichinosis.—The parasite of this disease (*Trichinella spiralis*) is of very common occurrence in both *Mus norvegicus* and *Mus rattus*. We have encountered it here only in *Mus norvegicus*. An examination of the diaphragms of several hundred rats shows about 3 per cent to be infected with this parasite. We have depended on the naked-eye examination, aided by a hand lens, and when the muscle presented a suspicious appearance we have resorted to the microscope to determine the diagnosis. A number of diaphragms (about 70) were examined with the low power of the microscope in the absence of any macroscopic signs of infection, but the result did not justify the added labor. Very frequently the granular condition of the muscle is so well marked that the infection may be detected at a glance after one has become familiar with the appearance. It is quite likely that a higher percentage of infection would be found if every rat were subjected to a careful microscopical examination. Braun (Animal Parasites of Man, New York, 1906) states that in Boston 10 per cent of the rats have trichinosis, and that 8.3 per cent of a large number of rats collected in Saxony, Bavaria, Würtemberg, and Austria were infected. No excessive percentage of infection was found in rats from the slaughterhouse district of the city.

The well-known bladder worm of rats, *Trichosomum crassicaudum*, is very common. Probably 20 per cent of the rats examined are infected with this parasite.

A round worm is not infrequently encountered in the stomach. The organ is usually packed with the parasites, which vary in length from 2 to 10 centimeters. This parasite has not yet been identified.

The only intestinal parasite identified is a tapeworm, *Hymenolepis diminuta*. According to Stiles (Bull. No. 25, Hygienic Laboratory, U. S. Public Health and Marine-Hospital Service, Washington, D. C.) this is "a rare and probably accidental parasite of man; easily expelled."

Hymenolepis nana, a tapeworm which is parasitic for both man and rats, has not been encountered though a somewhat careful search has been made for it on several occasions.

The parasite most frequently met with has been identified by Passed Assistant Surgeon Goldberger, Public Health and Marine-Hospital Service, as *Cysticercus fasciolaris*, the cysticercus stage of the cat tapeworm, *Taenia crassicollis*. The cysticercus is found in the rat's liver, from one to a hundred or even more being found in an infected animal. In a series of 1,500 rats examined to ascertain the frequency of this parasite 6.4 per cent were found to be infected. The parasite within the cyst membrane is often 15 or 20 cm. in length, and it strikingly resembles a mature tapeworm. The cyst wall surrounding this parasite is of three distinct types. The common type is a thin, tough, translucent membrane. Another form is one in which the membrane is developed into a tough, fibrous tumor mass, with walls sometimes 5 cm. or more in thickness. At least some of these fibrous capsules show evidence of malignancy. In the third form, which is very rare, the cyst wall is represented by a tough, leathery, opaque yellowish membrane. Calcareous placques are often found embedded in this membrane. In this latter form the parasite is dead and appears to be mummified.

A very common lesion of the liver is one in which there is a fine, yellowish-white thread-like structure winding very tortuously through the tissue of the organ. The differentiation from liver tissue is very distinct and clear. Microscopical examination shows the thread to be made up of an enormous number of oval objects that we are disposed to consider the ova of a parasite. These objects are quite uniform in size (0.03 mm. by 0.06 mm.) and shape. The shell is quite thick and is transversely striated. At each end is a translucent plug-like mass projecting a trifle above the general contour of the body and also extending a little into the cavity. The interior is quite filled, except for a small space at the ends, with a granular substance, which may be entire or which is more frequently divided into several masses (from 2 to 7).

Scabies.—A very common condition is a more or less extensive cauliflower-like excrescence on the ears of rats. This has been worked out by Acting Assistant Surgeon Wherry, Public Health and Marine-Hospital Service, as being due to the itch mite.

ORGANIC LESIONS.

The only lesion encountered connected with the circulatory apparatus was a case of extreme dilatation of the pericardium. The distended sac almost filled the entire cavity of the chest. The contents of the sac were a blood-stained fluid, and there was a large number of easily broken down adhesions connecting the visceral and parietal surfaces of the pericardium.

We have encountered only three conditions in the lung worthy of note. In the one, the lung contains well encapsulated masses of yellowish caseous material. These masses vary from the size of a pea to one replacing the whole lung. The condition is often bilateral.

The second condition is somewhat similar, but instead of being caseous, the contents of the capsule resemble the white of an egg with an admixture of purulent matter. This lesion has also been seen in our white rats. In the second condition the lesion is often multilocular. There are usually no pleural adhesions in either of the above conditions. It is astonishing how much of the lung may be replaced by these cystic formations. Rats have been seen in which certainly seven-eighths of the lung tissue had disappeared and its place been taken by these masses. No data as to the etiology of these conditions is at hand.

The third condition is much less frequent than either of the others. The lung presents areas of consolidation from mere points to those involving the half of a lung. No evidence of cavity formation has ever been seen. The appearance of this lesion strongly suggests the stage of gray hepatization of lobar pneumonia in man. The microscopical examination of one of these areas shows the air spaces of the lungs to be filled by an infiltration of mono-nuclear and poly-nuclear leucocytes. Even the smaller bronchi are entirely occluded.

Smears from each of the above conditions have been stained for tubercle bacilli, but always with a negative result. In view of the very filthy habits of the rat, one would expect to find tuberculosis very prevalent among them, but we have not seen a rat in which tubercular lesions could be demonstrated. The striking absence of any lesions that might be attributed to the tubercle bacillus led us to inoculate some rats with cultures of this organism. While it is not intended to discuss here this subject in detail, it may be said that of the 14 rats (*Mus norvegicus*) inoculated (7 with a bovine strain and 7 with a human strain) all were killed on the thirty-first day and only one presented at autopsy any lesion that could be regarded as probably due to the inoculation. In this case there was an abscess located between the liver and the diaphragm. It contained a thick, yellowish pus, and a moderate number of acid-fast bacilli were demonstrated in the contents; most of the bacilli, however, were larger than the average *Bacillus tuberculosis.*

The following lesions have been noted in connection with the digestive tract:

Hob-nail liver.—A lesion is occasionally found in which there is an accurate duplication of the gross and microscopic appearances of atrophic cirrhosis of the liver in man. The capsule of the organ is very much thickened and there is an enormous increase in the connective tissue surrounding the portal vein. The comparison to be complete should show ascites, but it has not been encountered in these cases. An enormous ascites is seen very rarely, but the cause has not been determined.

During this campaign against the rat much poisoning has been done with phosphorus and it is not surprising that many livers have been seen showing the macroscopic and microscopic signs of fatty degeneration. A few livers have been seen in which the fatty change was so far advanced as to cause the organ to float in water. The great majority of the cells have the protoplasm replaced almost entirely by fatty granules. In this connection it may be stated that the few cases of experimental phosphorus poisoning in rats that have been seen have not shown fatty degeneration. The rats have died within thirty-six hours from the time of eating the poison and have shown only a mild grade of gastro-intestinal inflammation. The tissues in these cases have not been submitted to microscopical examination.

A somewhat common lesion is one in which the liver is yellowish and granular, strongly resembling the appearance of the organ in plague infection. The spleen is enlarged and has many granules about the size of a mustard seed. This is the appearance we have seen in the organs of animals that have been fed for test purposes with the various biological products (" Ratin," " Ratite," etc.) designed to destroy rodents. It is probable that the similar condition seen in wild rats is due to the use of these agents.

A very rare condition of the liver is one in which the liver is studded with grayish, semigelatinous granules. These granules may be as small as the head of a pin or as large as a pea or even larger. The infiltration of the organ may be extreme, so that very little liver tissue may remain. Two cases have been carefully observed. One of these presented lesions in the spleen similar to those in the liver. Sections have shown an almost entire replacement of the liver tissue by an infiltration of large and small round cells and poly-nuclear cells. The appearance of the sections indicates that at least nine-tenths of the liver structure has been replaced by this new tissue.

Several cases of intestinal hernia have been seen. In each case the bowel has been reducible. The capacity of the sac was about 5 cc. in each instance. One hernia of the spleen has been observed. The organ was surrounded by a purulent exudate and lay directly beneath the skin. The opening through the abdominal muscles was about

1 cm. in diameter and was situated about 2 cm. below the costal margin, and the same distance in front of the midaxillary line. Stout adhesions, which prevented any access of purulent matter to the abdominal cavity, were found at the neck of the sac. The spleen itself appeared to be normal.

The following lesions of the genito-urinary tract have been observed:

Nephritis.—It was a matter of considerable surprise to note that a number of wild rats are the victims of marked, parenchymatous nephritis. The normal kidney of the rat is reddish brown and varies in size with the size of the rat. In the cases of nephritis the lesion is very apparent to the naked eye. The kidneys are larger than the size of the rat would lead one to expect, usually yellowish brown or slate colored, and are very friable, breaking down readily when pressure is made upon them. Cysts as large as a pea, or even much larger, are not rare, and small cysts up to about 1 mm. in diameter are very common in these cases of nephritis. The capsule usually strips readily.

This condition is found in about 60 per cent of the rats suffering from the leprosy-like disease to which reference is made below, but it is by no means rare in rats in general.

Microscopical examination shows the epithelium of the tubules to be largely desquamated. The nuclei of the cells are lost, or take the stain poorly. A few small cysts are seen scattered through the organ, and they may be quite numerous directly beneath the capsule. The process does not appear to affect the large collecting tubules, and the glomeruli are generally but little altered. In some areas there may be marked increase in connective tissue. It is a matter of surprise that an animal should live long enough for such an extreme disorganization as we have sometimes seen to take place. One might have been in doubt as to the origin of the tissue under examination but for the presence of fairly well-formed glomeruli.

In this connection, mention may be made of a rat that at first sight appeared to possess but one kidney, an organ that was normal in every respect. Close examination showed that the missing kidney was represented by a small, flattened mass of tissue which, upon microscopical examination, was found to present the following appearance: The glomeruli were about half the diameter of those in the normal organ. A few small cysts were seen. An occasional cell-grouping suggestive of tubuli was found and the remainder of the organ, which was by far the greater bulk, was made up of fibrous tissue. The capsule was much thickened. The ureter was reduced to a fine fibrous cord.

Vesical calculi.—Concretions in the bladder are not at all rare. The commonest form consists of small, dirty white, irregular, friable masses. Upon two occasions well-developed calculi were encountered. In one case 21 smooth, round stones, weighing a total of 3.8 grams, were found. The most remarkable case was that of a full-grown female *Mus norvegicus*, in which the bladder contained 6 stones weighing 7.8 grams, the largest one weighing 5 grams. In both of these cases a high degree of cystitis was evident to the naked eye.

Abscesses of the genital organs are occasionally encountered. In males they appear to spring from the seminal vesicles; in females they originate in the uterus or a higher part of the genital tract. In one case, just above its bifurcation, one division of the uterus was occluded by a caseous mass about the size of a pea. Above this point that division of the uterus was about 10 cm. long and uniformly dilated, the diameter being over 1 cm. This sac was filled with a thin, watery pus. Microscopical examination of the caseous mass and the contents of the sac threw no light upon the cause of the condition. The other division of the uterus contained 6 fetuses.

Tumors.—New growths are frequently encountered. Lipomata, fibromata, adenomata, sarcomata, and carcinomata are the types that have been identified. Four of the more interesting cases will be mentioned. Three were in full grown female rats; one in an adult male rat. The largest tumor we have seen was one situated in the groin. The shape was that of a flattened sphere, 6 cm. in its greatest diameter by 4 cm. in the shorter diameter. It was firm and tough, and in one part it contained a small purulent focus. The total weight of rat and tumor was 335 grams, of which the tumor represented 72 grams. The tumor was shown by microscopical examination to be a carcinoma.

The second case was one of the few uterine tumors encountered. Springing from the left branch of the uterus, just above the bifurcation, was a large spherical mass about 3 cm. in diameter. The mass was deep red in color, very friable, and was traversed by heavy bands of tissue. The diagnosis of sarcoma was made microscopically.

The most interesting tumor case encountered was one in which several large, hard tumors were found in the liver, with smaller nodules scattered throughout the belly cavity. The striking feature of the case was marked jaundice, visible even through the hair, but seen to be a most intense lemon yellow when the skin was reflected. A considerable mass of tumor tissue surrounded the common bile duct, thus accounting for the jaundice. Unfortunately, the tissue for microscopical examination was lost.

The fourth was a case in which one testicle was about four times the normal size. The organ was deep red in color, very friable, and upon section much blood escaped. Microscopical examination showed the tissue to be an angio-sarcoma.

Miscellaneous conditions.—A peculiar change in color of the hair has been observed in rats confined for several months in our stock cages. Large patches of the hair begin to grow light in color and close examination shows that many of the hairs have become quite white; others are whitened at the tip only.

A microscopical examination of these whitened hairs showed a tricophyton-like structure to be present. A similar structure was present in control preparations made from the hair of healthy rats. The cause of the condition is therefore as yet undetermined.

Subcutaneous abscesses in general and purulent conditions of the peripheral lymph glands are common. We were at one time inclined to regard the latter as possibly representing lesions of chronic plague, as described by the Indian Commission (Journal of Hygiene, vol. 7, No. 3). A considerable number have been submitted to the inoculation test, but always, thus far, with negative results.

Probably the most interesting lesion is the leprosy-like disease that has been described in Russia, Germany, Australia, and recently in San Francisco, where it was first observed by Acting Assistant Surgeon Wherry, Public Health and Marine-Hospital Service (Journal

American Medical Association, June 6, 1908). A special report on this disease has been submitted to the Surgeon-General (Public Health Reports, July 10, 1908, Vol. XXIII, No. 28).

I am indebted to Passed Asst. Surgs. Carroll Fox and Richard Creel for assistance in the histological work reported in these notes.

Identification of Fleas at San Francisco, Cal.

[By Passed Assistant Surgeon CARROLL FOX.]

In connection with plague suppressive measures in San Francisco, a routine examination has been made of fleas in the Federal laboratory since April 7, 1907. This work has been carried on in order to determine the different species of fleas and the predominant species infesting rats in San Francisco. Since July 1, 1908, an effort has been made to determine the species in relation to the number on individual rats. District officers have been ordered to bring the rats trapped alive to the district headquarters, where they are chloroformed, and an immediate search is made for siphonaptera. The fleas from each rat are then put in 70 per cent alcohol in separate bottles and forwarded to the laboratory properly labeled with the date, host, and district.

In all, 7,022 specimens have been examined to July 31, 1908, including 1,271 fleas from man. The figures given in detail below show that the *Ceratophyllus fasciatus* is the common rat flea in this locality, while the *Pulex cheopis* follows, not a very close second, the proportion being about three to one. Most of the *Pulex cheopis* have come from districts 4, 6, and 12. Districts 4 and 6 are inside districts, while district 12 is on the water front. From districts 4 and 6 a *Mus rattus* is very rarely caught, showing that there is no relation between the Indian rat and the Indian rat flea. The number of fleas per rat varies greatly; many rats seem not to be infested at all, while from one rat 157 fleas were obtained. Not including the rat with 157 fleas, the average number of fleas per rat is 4.5.

It will be noticed that of the 1,271 fleas taken from man, not one was a *cheopis* and only 4 were *Ceratophyllus fasciatus*, the common rat flea here. The finding of these might be accounted for by the fact that they were taken by the rat catchers from their own persons.

Host.	C. fasciatus.		P. cheopis.		P. irritans.		Cten. musculi.		C. canis.		Total.
	Male.	Female.	Male.	Female.	Male.	Female.	Male.	Female.	Male.	Female.	
Mus norvegicus	1,343	2,510	485	837	31	76	78	211	16	31	5,618
Mus rattus	23	43	3	3	0	0	17	16	1	0	106
Mus musculus	4	10	1	0	0	0	2	10	0	0	27
Homo sapiens	0	4	0	0	500	764	0	0	2	1	1,271
Total fleas examined to July 31, 1908											7,022

These figures do not include several hundred specimens obtained from other hosts, such as *C. acutus* and *Hoplopsyllus anomalus* from *Cetellus Beecheyi; C. ignotus* from *Thomomys Bottæ*, and several other species not yet identified.